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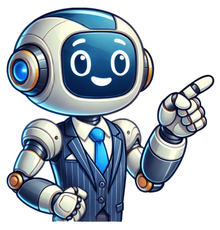

IntroductionAsteroids, sometimes called minor planets, are rocky remnants left over from the early formation of our solar system about 4.6 billion years ago. The current known asteroid count is: . Most of this ancient space rubble can be found orbiting our Sun between Mars and Jupiter within the main asteroid belt. Asteroids range in size from Vesta the largest at about 329 miles (530 kilometers) in diameter to bodies that are less than 33 feet (10 meters) across. The total mass of all the asteroids combined is less than that of Earth's Moon. Many Shapes and Sizes Most asteroids are irregularly shaped, though a few are nearly spherical, and they are often pitted or cratered. As they revolve around the Sun in elliptical orbits, the asteroids also rotate, sometimes quite erratically, tumbling as they go. More than 150 asteroids are known to have a small companion moon (some have two moons). There are also binary (double) asteroids, in which two rocky bodies of roughly equal size orbit each other, as well as triple asteroid systems. Composition Composition The three broad composition classes of asteroids are C-, S-, and M-types. The C-type (chondrite) asteroids are most common. They probably consist of clay and silicate rocks, and are dark in appearance. They are among the most ancient objects in the solar system. The S-types ("stony") are made up of silicate materials and nickel-iron. The M-types are metallic (nickel-iron). The asteroids' compositional differences are related to how far from the Sun they formed. Some experienced high temperatures after they formed and partly melted, with iron sinking to the center and forcing basaltic (volcanic) lava to the surface. The orbits of asteroids can be changed by Jupiter's massive gravity and by occasional close encounters with Mars or other objects. These encounters can knock asteroids out of the main belt, and hurl them into space in all directions across the orbits of the other planets. Stray asteroids and asteroid fragments have slammed into Earth and the other planets in the past, playing a major role in altering the geological history of the planets and in the evolution of life on Earth. Scientists continuously monitor Earth-crossing asteroids, whose paths intersect Earth's orbit, and near-Earth asteroids that approach Earth's orbital distance to within about 28 million miles (45 million kilometers) and may pose an impact danger. Radar is a valuable tool in detecting and monitoring potential impact hazards. By reflecting transmitted signals off objects, images and other information can be derived from the echoes. Scientists can learn a great deal about an asteroid's orbit, rotation, size, shape, and metal concentration. Asteroid Classifications Asteroid Classifications Main Asteroid Belt: The majority of known asteroids orbit within the asteroid belt between Mars and Jupiter, generally with not very elongated orbits. The belt is estimated to contain between 1.1 and 1.9 million asteroids larger than 1 kilometer (0.6 miles) in diameter, and millions of smaller ones. Early in the history of the solar system, the gravity of newly formed Jupiter brought an end to the formation of planetary bodies in this region and caused the small bodies to collide with one another, fragmenting them into the asteroids we observe today. Trojans: These asteroids share an orbit with a larger planet, but do not collide with it because they gather around two special places in the orbit (called the L4 and L5 Lagrangian points). There, the gravitational pull from the Sun and the planet are balanced by a trojan's tendency to otherwise fly out of orbit. The Jupiter trojans form the most significant population of trojan asteroids. It is thought that they are as numerous as the asteroids in the asteroid belt. There are Mars and Neptune trojans, and NASA announced the discovery of an Earth trojan in 2011. Near-Earth Asteroids: These objects have orbits that pass close by that of Earth. Asteroids that actually cross Earth's orbital path are known as Earth-crossers. How Asteroids Get Their Names How Asteroids Get Their Names The International Astronomical Union's Committee on Small Body Nomenclature is not very strict when it comes to naming asteroids. As a result, out there orbiting the Sun we have a giant space rock named for Mr. Spock a cat named for the character of "Star Trek" fame. There's also a space rock named for the late rock musician Frank Zappa. There are more somber tributes, too, such as the seven asteroids named for the crew of the Space Shuttle Columbia killed in 2003. Asteroids are also named for places and a variety of other things. (The IAU discourages naming asteroids for pets, so Mr. Spock stands alone). Asteroids are also given a number, for example (99942) Apophis. The Harvard Smithsonian Center for Astrophysics keeps a fairly current list of asteroid names. Additional Resources Additional Resources NASA's Planetary Defense Coordination Office Center for Near Earth Object Studies Minor Planet Center Introduction The planetary system we call home is located in an outer spiral arm of the Milky Way galaxy. Our solar system consists of our star, the Sun, and everything bound to it by gravity the planets Mercury, Venus, Earth, Mars, Jupiter, Saturn, Uranus, and Neptune; dwarf planets such as Pluto; dozens of moons; and millions of asteroids, comets, and meteoroids. Beyond our own solar system, there are more planets than stars in the night sky. So far, we have discovered thousands of planetary systems orbiting other stars in the Milky Way, with more planets being found. Most of the hundreds of billions of stars in our galaxy are thought to have planets of their own, and the Milky Way is but one of perhaps 100 billion galaxies in the universe. While our planet is in some ways a mere speck in the vast cosmos, we have a lot of company out there. It seems that we live in a universe packed with planets a web of countless stars accompanied by families of objects, perhaps some with life of their own. Namesake Namesake There are many planetary systems like ours in the universe, with planets orbiting a host star. Our planetary system is called the solar system because we use the word solar to describe things related to our star, after the Latin word for Sun, "solis." Size and Distance Size and Distance Our solar system extends much farther than the eight planets that orbit the Sun. The solar system also includes the Kuiper Belt that lies past Neptune's orbit. This is a sparsely occupied ring of icy bodies, almost all smaller than the most popular Kuiper Belt Object dwarf planet Pluto. NASAs New Horizons spacecraft captured this high-resolution enhanced color view of Pluto on July 14, 2015. Credit: NASA/JHUAPL/SwRI | Full caption and image Beyond the fringes of the Kuiper Belt is the Oort Cloud. This giant spherical shell surrounds our solar system. It has never been directly observed, but its existence is predicted based on mathematical models and observations of comets that likely originate there. The Oort Cloud is made of icy pieces of space debris - some bigger than mountains orbiting our Sun as far as 1.6 light-years away. This shell of material is thick, extending from 5,000 astronomical units to 100,000 astronomical units. One astronomical unit (or AU) is the distance from the Sun to Earth, or about 93 million miles (150 million kilometers). The Oort Cloud is the boundary of the Sun's gravitational influence, where orbiting objects can turn around and return closer to our Sun. The Sun's heliosphere doesn't extend quite as far. The heliosphere is the bubble created by the solar wind a stream of electrically charged gas blowing outward from the Sun in all directions. The boundary where the solar wind is abruptly slowed by pressure from interstellar gases is called the termination shock. This edge occurs between 80-100 astronomical units. Two NASA spacecraft launched in 1977 have crossed the termination shock: Voyager 1 in 2004 and Voyager 2 in 2007. Voyager 1 went interstellar in 2012 and Voyager 2 joined it in 2018. But it will be many thousands of years before the two Voyagers exit the Oort Cloud. Moons Moons There are more than 200 known moons in our solar system and several more awaiting confirmation of discovery. Of the eight planets, Mercury and Venus are the only ones with no moons. The giant planets Jupiter and Saturn lead our solar systems moon counts. In some ways, the swarms of moons around these worlds resemble mini versions of our solar system. Pluto, smaller than our own moon, has five moons in its orbit, including the Charon, a moon so large it makes Pluto wobble. Even tiny asteroids can have moons. In 2017, scientists found asteroid 3122 Florence had two tiny moons. These six narrow-angle color images were made from the first-ever 'portrait' of the solar system taken by Voyager 1, which was more than 4 billion miles from Earth and about 32 degrees above the ecliptic. Credit: NASA Planetary Photojournal Formation Formation Our solar system formed about 4.5 billion years ago from a dense cloud of interstellar gas and dust. The cloud collapsed, possibly due to the shockwave of a nearby exploding star, called a supernova. When this dust cloud collapsed, it formed a solar nebula a spinning, swirling disk of material. At the center, gravity pulled more and more material in. Eventually, the pressure in the core was so great that hydrogen atoms began to combine and form helium, releasing a tremendous amount of energy. With that, our Sun was born, and it eventually amassed more than 99% of the available matter. Matter farther out in the disk was also clumping together. These clumps smashed into one another, forming larger and larger objects. Some of them grew big enough for their gravity to shape them into spheres, becoming planets, dwarf planets, and large moons. In other cases, planets did not form: the asteroid belt is made of bits and pieces of the early solar system that could never quite come together into a planet. Other smaller leftover pieces became asteroids, comets, meteoroids, and small, irregular moons. Structure Structure The order and arrangement of the planets and other bodies in our solar system is due to the way the solar system formed. Nearest to the Sun, only rocky material could withstand the heat when the solar system was young. For this reason, the first four planets Mercury, Venus, Earth, and Mars are terrestrial planets. They are all small with solid, rocky surfaces. Meanwhile, materials we are used to seeing as ice, liquid, or gas settled in the outer regions of the young solar system. Gravity pulled these materials together, and that is where we find gas giants Jupiter and Saturn, and the ice giants Uranus and Neptune. You are using an outdated browser. Please upgrade your browser to improve your experience.HISTORY: Scientists with data from Mariner 2, the first spacecraft to reach another planet (Venus). Information on this site is gathered either directly from scientists and engineers working on active missions or from Websites from global space agencies, including NASA and the European Space Agency. We also rely on information provided by research and development centers, national and international observatories, private observatories and others on the list below. We use a best of approach with images, selecting a key set of images that best tell the story of the planet, celestial object or spacecraft. Comprehensive planetary image libraries can be found at and . Many missions and observatories also have excellent and unique image collections. These are the primary sources for information on this site: Jet Propulsion Laboratory Solar System Dynamics Goddard Space Flight Center National Space Science Data Center International Astronomical Union Universities Other Sources New modeling indicates that the grooves on Mars moon Phobos could be produced by tidal forces the mutual gravitational pull of the planet and the moon. Initially, scientists had thought the grooves were created by the massive impact that made Stickney crater (lower right). Image Credit: NASA/JPL-Caltech/University of Arizona Phobos was discovered on Aug. 17, 1877 by Asaph Hall. Overview Phobos, gouged and nearly shattered by a giant impact crater and beaten by thousands of meteorite impacts, is on a collision course with Mars. Phobos is the larger of Mars' two moons and is 17 x 14 x 11 miles (27 by 22 by 18 kilometers) in diameter. It orbits Mars three times a day, and is so close to the planet's surface that in some locations on Mars it cannot always be seen. Phobos is nearing Mars at a rate of six feet (1.8 meters) every hundred years; at that rate, it will either crash into Mars in 50 million years or break up into a ring. Its most prominent feature is the 6-mile (9.7 kilometer) crater Stickney, its impact causing streak patterns across the moon's surface. Stickney was seen by Mars Global Surveyor to be filled with fine dust, with evidence of boulders sliding down its sloped surface. Phobos and Deimos appear to be composed of C-type rock, similar to blackish carbonaceous chondrite asteroids. Observations by Mars Global Surveyor indicate that the surface of this small body has been pounded into powder by eons of meteoroid impacts, some of which started landslides that left dark trails marking the steep slopes of giant craters. Measurements of the day and night sides of Phobos show such extreme temperature variations that the sunlit side of the moon rivals a pleasant winter day in Chicago, while only a few kilometers away, on the dark side of the moon, the climate is more harsh than a night in Antarctica. High temperatures for Phobos were measured at 25 degrees Fahrenheit (-4 degrees Celsius) and lows at -170 degrees Fahrenheit (-112 degrees Celsius). This intense heat loss is likely a result of the fine dust on Phobos' surface, which is unable to retain heat. Phobos has no atmosphere. It may be a captured asteroid, but some scientists show evidence that contradicts this theory. How Phobos Got its Name Hall named Mars' moons for the mythological sons of Ares, the Greek counterpart of the Roman god, Mars. Phobos, whose name means fear is the brother of Deimos. Raw images are photos from space missions that NASA provides online for easy public access in their original (usually monochrome) appearance, largely untouched by image processing software. Raw images, in this context, are generally not the same as truly "raw" science data meaning the original image data format returned to Earth by spacecraft. They're more like high-quality previews of data received from missions. At left is an unprocessed, or raw, image from NASA's Cassini spacecraft. The image was taken using a filter that lets red wavelengths of light pass through to the camera's sensor. This image and two others, taken in green and blue light, were combined to create the color view at right. Credit: NASA/JPL-Caltech/SSI Processed images from these missions are available at the Psyche mission website and Cassini mission website. NASA space missions return lots of images to Earth far more than featured images the agency posts on the web and in social media. For example, a long-lived mission like Cassini could return hundreds of thousands of images over its lifetime. All the science data returned by NASA's space missions is permanently archived in the Planetary Data System, or PDS, as a public resource. (You can search for data in the PDS here.) This includes every bit of the original science-quality space image data from NASA missions. That means researchers present and future, as well as anyone else, anywhere in the world, can access the data themselves. However, archival image data products don't show up in the PDS immediately. They go through a rigorous process called validation, in which they are carefully checked for quality and packaged in a standardized electronic format. This process usually takes six months to a year from the time images are sent to Earth. In order to enable everyone to have access to these unprocessed space images soon after they arrive on Earth sometimes within a couple hours NASA makes what we call "raw" versions of these images available online. Other NASA raw image galleries Some raw images from NASA missions are posted here. Others are posted on mission websites, such as the Mars rovers Curiosity and Perseverance. In time, the agency may combine more mission raw images in a central place like this page.

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